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SIGMA XI QUARTERLY

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39TH ANNUAL CONVENTION RICHMOND, VA., DECEMBER 28

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CIRCULATION THIS ISSUE OVER 16,000

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SIGMA XI QUARTERLY

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THE 39TH ANNUAL CONVENTION

The 39th Annual Convention of the Society of the Sigma Xi is scheduled for Wednesday, December 28, at 4.00 P.M. in Richmond, Virginia, in conjunction with the meeting of the A. A. A. S.

The Executive Committee of the Society will meet at 12.00 of the same day in the Hotel Jefferson, which is the general headquarters for the meetings.

Chapters and clubs are entitled to send three delegates to the Convention. Chapters and clubs are urged to appoint as delegates individuals who will be sure to be present at the Convention, to provide them with proper credentials for presentation to the Committee on Credentials at the Convention, and to send the names of the delegates to the national secretary as soon as appointed. They are also urged to communicate to the national secretary before December 1st any items of business which they may like to have the Executive Committee or the Convention consider, in order that place on the program may be assigned for such consideration.

Among the important items of business to come to the Convention is the following amendment to the constitution:

I. "That a Section 4 be added to Article II of the present constitution, reading:

Article II, Section 4. The charter of an established chapter of Sigma Xi may be revoked only by a three-fourths vote of a convention following a recommendation of the Executive Committee, which recommendation has been communicated to each chapter not less than four weeks before the date of the convention."

2. FORMAL PETITIONS FOR CHARTERS FOR CHAPTERS:

   a. University of West Virginia.

   b. University of Alabama.

   (Copies of these petitions have been sent to all chapter secretaries for chapter consideration. While the Executive Committee has not yet taken final action on these petitions, it may do so at its meeting just prior to the Convention, and if the petitions come before the Convention, chapters should be prepared to vote.)

3. REPORT OF OFFICERS FOR 1938.

4. REPORT OF COMMITTEE ON THE POLICY OF THE SOCIETY.

5. ELECTION OF OFFICERS:

   a. Member of the Executive Committee to succeed Professor Stadler, whose term of office expires this year.

   b. Member of the Alumni Committee to succeed Mr. Norton, whose term of office expires this year.

   The Nominating Committee consists of Prof. Ralph W. Chaney, University of California at Berkeley; Pres. Karl Compton, Massachusetts Institute of Technology; Prof. P. H. Mitchell, Brown University. Chapters may send their nominations to the National Secretary, or direct to the committee.

6. GENERAL BUSINESS.

   Chapters and clubs are asked to submit to the National Secretary items of business which they would like to bring to the Convention, in order that proper place for them may be provided on the agenda.

THE 17TH ANNUAL SIGMA XI LECTURE

The 17th annual Sigma Xi lecture under the joint auspices of the A. A. A. S. and the Society of the Sigma Xi will be given Wednesday evening at 8.30 by Dr. W. E. Durand on the topic, "Modern Trends in Air Transport."

SCIENCE AND RESEARCH IN MODERN CIVILIZATION*

M. L. Wilson
Undersecretary of Agriculture

I bring you on this occasion the greetings of the Secretary of Agriculture and of the United States Department of Agriculture. We believe that you can be justly proud of the service to agriculture rendered by the Florida Agricultural Experiment Station, and that this fiftieth anniversary of its founding is an event well worth celebrating.

There is a special appropriateness, too, in observing the fiftieth anniversary of the establishment of the agricultural experiment station concurrently with the installation of a chapter of the Society of the Sigma Xi. This is the scientific age. Sigma Xi represents the spirit and achievements of science. And there are probably no institutions wherein the progress of science has been more impressively reflected than in the agricultural experiment stations of America during the past half century.

The contributions of the Florida Station to the prosperity of Florida agriculture have been numerous and valuable. However, although you have properly concerned yourselves with local and state problems particularly, the benefits of your work have by no means been confined to a single state. Scientific discoveries and technical procedures developed here have contributed in an important way to the solution of problems elsewhere, and have added to the general accumulation of knowledge that science makes available for all humanity.

The researches of your station on the action of the minor fertilizer elements, especially copper, zinc, boron, cobalt, and manganese, have been of importance not only to your state but to the nation and to the progress of world soil science. The Florida Station has pioneered in the study of problems relating to the propagation, growth, and disease control of the tung oil tree which has materially contributed to the stability of this new industry throughout the Gulf States.

It is also generally recognized that the prompt efficiency with which you helped to repel the invasion of the most dreaded of all fruit pests—the Mediterranean fruit fly—saved the fruit-growing areas of the South from untold damage and loss. The invasion of this country by the black shank disease of tobacco might have led to the eventual abandonment of tobacco production in many parts of the tobacco belt had not the Florida Station succeeded promptly in breeding up varieties of cigar tobacco resistant to the disease. One of the most brilliant episodes in the never-ending struggle against plant disease was the eradication of citrus canker in Florida. In that case, your scientists had to devise new techniques for fighting the disease. These techniques were so expertly developed

* Address presented at special convocation on October 28, 1938, celebrating fiftieth anniversary of Agricultural Experiment Station and the installation of the Florida Chapter of the Society of the Sigma Xi.

that they were adopted by the Bureau of Entomology and Plant Quarantine of the United States Department of Agriculture, and by other states where the disease occurred, with the result that citrus canker is being conquered everywhere. These are just a few of the many achievements that are widely known outside of Florida that have been based upon the scientific accomplishments of the Florida Agricultural Experiment Station. Director Newell and staff of the Florida Agricultural Experiment Station, I salute and congratulate you for your accomplishment for the State of Florida, for the nation and for all mankind.

There is another accomplishment that you may be proud of—in a different field, the field of education. I refer to your General College and to your system of making work in the humanities and in the fundamental sciences prerequisite to agricultural and other specialized or technical education. This is a development that is as important as the invention of a cotton picker or a combine, or the discovery of a new principle or application of chemistry. It is a response to a great social need.

Because of the cultural foundation that your General College seeks to provide, graduates of the College of Agriculture and of all the schools and colleges of the University of Florida should be not only efficient technicians, but also educated men and women with some understanding of the social and natural world in which they live. There is also good reason for confidence that the technical abilities of your graduates will be improved, rather than lowered, by the broadened training that is given here.

A survey that is being made of the scientific, administrative and technical personnel of the United States Department of Agriculture seems to offer good proof of this. This survey has not been completed for employees outside of Washington, but a tentative report upon the Washington staff has already been issued.

Questionnaires were sent to 1,500 scientific and administrative workers in the department, and 1,000 replies were returned. The questions were devised to find out where staff members had received their training, what that training had been, and what portions of their training had proved most valuable.

When these questionnaires were assembled and compilations made, one of the first observations was that there had been a long and steady increase in the percentage of non-agricultural college graduates who had joined the department staff. In the light of other facts, the reason for this appears to be that many or most agricultural colleges have not provided their students with the broad training that is required for the constantly broadening functions of the department.

The questionnaire asked what courses in college had been most valuable in the work in the department, and what courses and subjects should be most emphasized in training students for duties of that kind. The impressive thing about the replies was the emphasis placed upon the value of fundamental and so-called non-practical subjects, and upon such studies as the social sciences, mathematics, and foreign languages and literature.

A summary conclusion of the replies indicates that training in the social sciences is considered approximately equal in value and importance to training in practical agricultural subjects.

It is important that the sort of education you are striving to attain here should be the sort of education that will provide the best practicing scientists and administrators. But I believe it is even more important that your efforts in this direction will turn out the best citizens for this modern age of science. This point is so important, in fact, that it can hardly be overemphasized.

A year ago we celebrated the seventy-fifth anniversary of the founding of the Department of Agriculture and the passage of the Land-Grant College Act. When we first decided to hold some sort of celebration, we considered featuring the technical progress of agriculture during the seventy-five years that had elapsed since the department was founded. It was obvious that the scientific and technical progress during that period had been vast and impressive beyond even the wildest dreams of any earlier age.

Within the space of a single lifetime, American agriculture had progressed from a technical condition only one step removed from the wooden plow, the scythe and the flail, to the rubber-tired tractor and the combine. The machine has come, and its use is spreading rapidly. Germ plasm in both plants and animals has been vastly improved. There is a great and obvious difference between the hybrid corn of today and the Indian corn of our grandfathers, between the smooth, disease-resistant Margrobe tomato and the "love apple" of a century ago, between the modern pure-bred Holstein giving 9,000 pounds of milk annually and her scraggly ancestor doling out only 2,000 to 3,000 pounds per year, or between trap-nested white Leghorns producing 225 eggs per year in an electric-lighted hennery and old biddy who laid perhaps sixty eggs annually in the back of the haymow.

A display of this scientific progress would have been justly impressive, and would in one sense have been appropriate because for seventy-five years the greatest needs and desires of American agriculture had been for technical progress. And the department, along with agricultural colleges and experiment stations, had devoted itself during this period largely to the scientific development of farming.

Yet there was one great objection that could not be ignored. The most pressing problems in agriculture today are not technological problems, but social problems. The efforts to combat plant and animal diseases, to develop better germ plasm, to increase efficiency of operation, to improve our knowledge of soils—all such efforts must be continued without abatement. But it is beyond all question that the urgent, crucial problem of agriculture today is the matter of economic and social adjustment. It is the social dislocations and economic disparities that demand primary attention now.

The farmers of today are driven by the new conditions of this complex industrial civilization to think less about how to produce more cotton, or wheat, or citrus fruit, or corn, or butter fat, or truck crops, than about the problem of getting a fair return from what they do produce. It is less important for them to know how to build a silo or a barn than to find the means and mechanism whereby their own honest labor in the field and orchard and garden may be translated into a silo or a barn.

Our consciousness of this in the Department of Agriculture turned us away from the first plan, which was to observe our seventy-fifth anniversary by a

display of the technical progress of agriculture. Such a program, we felt, would be a glory in the past while ignoring the present and the future. Conscious of the nature and vastness of present problems, therefore, we centered our program around the historic association of agriculture with democracy and education. In doing so, we could take our inspiration from the past, and yet face the future. For it is a fact that the growth of real democracy in the United States was peculiarly associated with our agrarian traditions; and it was the farmers and their leaders who were primarily responsible for the development of our unique system of popular higher education. For this reason we could draw inspiration from the past. We believed we faced toward the future because of our deep conviction that the solution of today's problems must come within the framework of democracy, and must be rooted in popular education and enlightenment.

The world of agriculture has changed almost beyond recognition in the half century since our agricultural experiment stations were established. The unprecedented development of agricultural science and technology plus the vast scientific and technological developments throughout the whole fabric of modern civilization, have brought a long train of consequences that affect profoundly the lives of every one of us.

The commercialization of agriculture, which for centuries had proceeded with comparative gradualness, has been vastly accelerated in the last fifty years. The large measure of economic self-sufficiency that still characterized most American farms half a century ago has been to a great degree replaced by dependence upon the market. The farmer has to buy more, and he has to sell more, than he used to.

There was a time when he could survive a period of general economic distress with comparative ease simply by eliminating luxuries. Now his economic fate and private happiness have been irresistibly drawn into the orbit of the powerful but delicately adjusted world of modern economy.

As late as a quarter of a century ago the American farmer paid out nothing for power. In fact, collectively he put down a small profit item in the power column; for he used only horses and mules, and he sold more of these than he bought. It is estimated that in the last few years he has paid out about one billion dollars annually for power of all kinds. Farming in the past was somewhat unique among economic enterprises. The farm was a home, a family establishment producing for its own needs, and largely independent of the world.

The impact of the modern age, however, is in many regions altering vastly the older pattern of farm life. The farmer, in a significant number of cases is becoming a business man, a rural *entrepreneur* whose factory is a tract of land. Scientific management and the applications of technology make this sort of factory farming highly efficient as a producing enterprise, but with this increased efficiency has come an easy susceptibility to every ill that occurs anywhere in the economic order.

The capital costs of farming have advanced greatly, and the indebtedness of farmers has risen dangerously. Tenancy has increased steadily, and governmental efforts to assist operator-ownership have not been sufficient to stem the swelling tide. It is significant that these and related ills are almost invariably

most pronounced in those areas where farming is most highly specialized scientific and commercialized.

It is not in the economic phase alone that the farmer's isolation is gone. The city and the country have been brought closer together by the railroad, the automobile, hard-surfaced roads, the R. F. D. and parcel post, the telephone, the radio, and the motion picture. Our rural culture is being rapidly urbanized. Beauty columns in farm journals today tell farm wives how to tint their nails; farmers buy automobiles designed to appeal to the most fashionable residents of Park Avenue; many farm boys and girls see the same movies, play the same games, sing the same songs, and wear the same clothes as boys and girls in San Francisco or Chicago or New York City. Such a degree of mutuality of tastes, habits and concerns between country and city is something very new, and it may also be very important, because if this trend continues we may finally have to revise many of our assumptions concerning the differences between rural and urban culture.

The last fifty years have also witnessed the rise and growth of many organizations and institutions devoted to the service of American agriculture. There has been a vast extension of the Department of Agriculture to meet the increasing demands of the farm population. New problems and new needs have called into being the Farm Credit and Farm Security Administrations. Fifty years ago farmers were endeavoring by sporadic efforts to put over a campaign for better roads; now the Rural Electrification Administration is working to bring them electricity. There is the far-flung Extension Service with all its ramifications, federal, state and local; there are the Smith-Hughes teachers, the county agents, and the better farming organizations such as the 4-H Clubs and the Future Farmers of America. There are the agricultural colleges and experiment stations, and state agricultural commissions and departments. There are the farm organizations, both local and national, that farmers have formed for themselves; registry associations for pure strains of plants and animals, cooperative associations in great number for a variety of special purposes. Our highest intellectual institutions have in a way responded. Agriculture has been given a special field in economics, and farm life and culture have become the subject matter of a special branch of sociology. A multitude of institutions have been developed to serve the interests of agriculture in an ever-widening sphere.

The changes that have taken place in agriculture during the fifty years since the Florida Station was founded are merely agriculture's share of the changes that have been occurring throughout the modern world. Everywhere, science and technology have been making a social revolution. Specialization and corresponding interdependence have been rapidly developing. Commercial emphasis has grown. Distances have shrunk; and cultural disparities based on geography have been greatly reduced.

Back of all the changes that have made this modern world of ours is science. When science has not been the cause, it has been the medium. The natural sciences have supplied society with cumulative power over the forces of nature. There are certain very portentous features of this modern development of science. In the first place, the development and applications of science have proceeded with increasing rapidity, and the rate of change during the past half

century is clearly unprecedented in all history. In the second place, the social sciences have lagged far behind, and our effective knowledge of man as a social being has been pitifully small.

For a long time, the scientific world was characterized by a spirit of unquestioning optimism. It assumed without debate that every extension of man's control over the physical world was unqualified good. But recently this attitude has been seriously questioned by some of the most distinguished men in the scientific world. Science, in other words, is beginning to realize that scientific and technological developments affect society profoundly, and in a way that the natural scientist cannot always foresee.

It was this appreciation of the social implications of scientific growth that led the British Association for the Advancement of Science to devote its major attention in this year's meeting to a discussion of the social problems that science itself has created. More than one great scientist in recent years has declared himself appalled at the uses or the effects of his discoveries. Consider the instruments of destruction and mass murder that science has already put in the hands of war-makers; and consider, also, the terrible means of death and devastation that science may in the future devise or clear the way for. On this score, I should like to read a few sentences from *World Chaos, The Responsibility of Science,* by the great philosopher, Professor William McDougall:

> ". . . . if some physicist were to . . . . teach us to unlock the energy within the atom, the whole race of man would live under the threat of sudden destruction . . . . no discoveries . . . . that physical science could possibly make, could . . . . remedy our condition . . . . every step of progress physical science may make in the near future can only add to our dangers and perplexities; for every step of such progress must increase the top-heaviness and lop-sidedness which are the radical faults of our civilization.
>
> "I have no wish to belittle the achievements of physical science. They are immense and altogether admirable. I am concerned only to bring home to the minds of my readers the indisputable fact that the very successes of physical science lead . . . . to rapid and violent changes in all our modes of living, and are producing a state of affairs that is ever more unstable and dangerous. . . ."

Science has, indeed, placed terrifying power in the hands of man.

And yet I believe that the most far-reaching social problems that science has created are those that are less obvious, less direct, and less sensational. Science has given us railroads, electric lights, plumbing systems, refrigeration, automobiles, telephones, radios, and a hundred other things that we have come to regard almost as necessities. But the getting of these things has involved the creation of conditions out of which has come the bitter struggle between capital and labor, has brought first specialization, then dependence, then insecurity; has resulted in dangerous maldistribution of wealth; has involved the bewildering and tragic paradox of poverty in the midst of potential plenty, of mass unemployment, idle factories, and bulging granaries with no buyers, yet many hungry

Science and technology have, in effect, changed man's physical world. And in changing his physical world, they have altered his social institutions. Individual man is a resilient, adaptable creature, and so-called human nature, as anthropologists have demonstrated, is almost infinitely variable. Yet social man and social institutions, although they change constantly, change very slowly. This rapidity of scientific advance, coupled with the natural slowness of social evolution, has created institutional conflicts and maladjustments that are more severe and far reaching than any that man's previous history records.

The insecurity and suffering of great masses of mankind under strange new conditions for which the traditions and the lore of the past provide no real explanation, have caused a popular bewilderment that is the tragic characteristic of this age. The confused desperation of the times has bred strange and contradictory creeds, has stirred dormant hatreds and intolerance. Some people, while welcoming every scientific and mechanical innovation, react with better hostility toward every new social idea, and seek to return to the social and economic traditions of the age of hand looms and stagecoaches while enjoying the material luxuries of mass production industry and Pullman cars. Still others chase after every nostrum that quacks can manufacture and embrace every new social doctrine that appears.

In the face of this situation, it is the considered opinion of many far-sighted scientists today that the most important task confronting this modern age is to bring humanity and applied science into adjustment, and to find social controls that will in some way make society the master, rather than the helpless pawn, of its technological accomplishments.

There are those who would advise us to retreat from science, to throw away the controls over physical forces that science has given us, and live in a Golden Age without any of those modern things that produce both the material blessings and the social problems characteristic of the modern world. This suggestion might be worth discussing, except for one thing—it is plainly impossible.

The realistic course is not to dream fondly of abandoning science—but to *extend* science. We must extend science more and more into the field of social relationships. If you will follow the history of science, you will find, like Professor George Sarton of Harvard and Professor Lancelot Hogben of the London School of Economics, that science has forever been, in the best sense of the word, utilitarian. Science has made its discoveries and applications, and has advanced man's understanding, in response to human needs.

We must, in the words of Professor Sarton, turn this machine age into a truly scientific age. This involves three major points. There must be an ethical development comparable to our technological progress. There must be progress in the social sciences sufficient to bring them abreast of the physical sciences. And there must be an educational program that will give to all the people the best possible understanding both of our natural world and of our social processes.

The ethical development must grow out of a profound appreciation of the social and moral responsibilities that devolve upon each individual in this scientific age. Science itself must examine its social conscience, must consider the social implication of its achievements, and in a humanistic sense become purposeful. We must become socially-minded. Consideration of the rights of

others, which in some form or other is a basis of every ethical code that we can conceive, must develop new refinements. For the kind of conduct which in an earlier age was, so to speak, our own business, may now affect vitally the lives and interests of people we never heard of, and of whose very existence we are ignorant.

The social sciences must provide us with a better understanding of the world of men. They face what is perhaps a crucial responsibility. The social sciences are young, and they suffer perhaps from the fact that in the envy of youth they have borrowed too much from the methods of the more mature natural sciences. Specialization, and the separation of inseparable phenomena into artificial categories has gone too far. The desire to make quantitative measurements has too frequently resulted in computations based on data that are extremely dubious. But the difficulties of the social sciences, wherein controlled experiments are generally out of the question, are so great that we must be tolerant of mistakes and false starts so long as the exploration for new methods and departures is continued.

Yet it seems to me that there is room for a considerable degree of optimism in two rather recent developments within the social sciences. The first of these is the progress made within the past generation by cultural anthropology. Cultural anthropology has developed methods of study that are truly scientific, and which are applicable to social data regarding so-called civilized man as well as primitive man. The implications of findings already made in this field are of real value in our approach to the problems of contemporary society. The second reason for optimism is that leading social scientists everywhere are beginning to reveal an impatience with the artificial categories which have traditionally separated their subject matter. Just as physics, mathematics, and chemistry cooperate to solve problems in the natural world, or as biochemistry developed out of a need for the combined service of two disciplines, the social sciences are learning that the problems confronting them can often be successfully undertaken only by the united efforts of two or more branches of knowledge.

Finally, there must be a program of popular education that will provide all our people with the means of understanding the world in which we live. There is neither vitality nor value in science that remains cloistered and out of contact with humanity. It will do no good to develop our ethics and social sciences if they are not shared by the mass of men. It will serve no good purpose for a few men to learn a great deal about social structures and processes unless the essence of that knowledge is made available to all the individuals who make up our society.

I believe that any real solution of our social problems today must come within the democratic framework and by rational processes. Cynical attempts to manipulate people, even when benevolently intended, will always prove self-defeating if human dignity and personal freedom are among the social ends we desire. The mass of our citizenry must know enough about social processes to be the real initiators and makers of such social reforms as the world demands.

The land-grant colleges and state universities are in a very real sense an experiment in democracy. At the time they were founded it was the fashionable belief imported from Europe that education was proper, and possible, only for

the aristocrats and the well-to-do. But the farmers and working people of America insisted so strongly upon the necessity of education to democracy, and upon the right of all the people to as much education as they could assimilate, that the pressure of this insistence brought the land-grant colleges into being. And if these colleges are used today to aid the cause of democracy, and to facilitate the scientific and democratic solution of the urgent social problems of this age, it will be in complete conformity to the spirit in which they were founded.

This, I believe, is the course that the University of Florida is pursuing in requiring that all of her students, including those in agriculture and engineering, shall have some fundamental training in the humanities and the social sciences. Colleges, and progressive educators and men of science elsewhere are more and more looking to Florida as a pioneer in the kind of cultural training that the technicians of this age must have. No one would claim that you have found the philosopher's stone or that sudden miracles will be accomplished; but there can be little doubt that you are headed in the right direction, that you are furthering the cause of true democracy, and that you are setting science to its true task of serving humanity.

EXTRA-SENSORY PERCEPTION*

J. B. RHINE
Duke University

There has long existed a deeply entrenched belief that nothing can enter the mind save through the channels of sense. It is a doctrine of speculative philosophy that dates from well beyond the beginnings of experimental psychology. Although entirely lacking in experimental proof, it has become so venerable a dogma as not to require, in the view of most scientific men, any actual demonstration.

About eight years ago there were begun at Duke University some simple experiments designed to put this psychological dogma to test; that is, to inquire whether an extra-sensory mode of perception was experimentally demonstrable. The conditions of the experiments were so planned, with a view to excluding sensory perception, that if definite results were obtained that were more than merely accidental, there would be no alternative to concluding that extra-sensory perception had occurred.

The general design of these tests consisted in a card-calling procedure in which the subject was asked to try to name the cards as they occurred in a shuffled pack inverted before him. A suitable pack of twenty-five cards consisting of five cards each of five suits or symbols was designed especially for the tests, and a variety of test procedures were developed based on these.†

The precautions taken to exclude sensory stimuli were at first such as would be customary in a careful card game. Opaque, carefully inspected, hand-stamped cards were used on non-reflecting surfaces, with tactual cues excluded by requiring calling before touching. From these beginning conditions a number of experimental advances in precaution were made as success was attained in satisfying the criteria of conditions already adopted and as score averages were obtained that were reliably beyond the range allowable to chance.

* * *

The first important question to be critically considered was that of the chance hypothesis: In how far could the results of the tests be accounted for by chance alone? Were the scores significant of something beyond accident?

By common sense alone it was soon apparent that an extra-chance agency of some kind was demonstrated. By long series of successive hits, in repeated occurrences from day to day of total positive deviations when negative scores were quite as likely, in the effects of certain drugs upon the scoring, in the subject's ability to score generally at will above the mean or below according to whether he tried to hit or miss the cards—by these and other effects there was given a strong common-sense impression of the activity of something beyond chance factors. In the simple fact that a subject's calls averaged above

* Address before the Michigan Chapter.

† Descriptions of these are given in the literature, most of which is published in the *Journal of Parapsychology* (Duke University Press) and in the *Handbook for Testing Extra-Sensory Perception* by Pratt and Stuart, New York, 1937.

the mean when checked with the pack aimed at and gave only chance averages when checked against a wrong pack, we could see again by common sense alone that chance was outdone and that something else was required to account for the score totals obtained.

The application of mathematical methods to the evaluation of the scores was of course the principal basis of judgment, and the methods used have already been described in detail in many reports.* These methods offered the best fit then available and their essential applicability is amply certified in the following authoritative ruling recently rendered by Professor Burton H. Camp, president of the Institute of Mathematical Statistics, who states:

> Doctor Rhine's investigations have two aspects; experimental and statistical. On the experimental side, mathematicians of course have nothing to say. On the statistical side, however, recent mathematical work has established the fact that assuming that the experiments have been properly performed, the statistical analysis is essentially valid. If the Rhine investigation is to be fairly attacked it must be on other than mathematical grounds.

The statement by Doctor Camp embodies the views of a number of eminent mathematicians and represents a "Supreme Court decision" on an issue that has been somewhat incautiously controverted by fellow-psychologists.

Mathematical work stimulated by the peculiar needs of this research has lately provided alternative, and in some cases more precise, methods for the evaluation of the probability of the ESP test results, and the mathematical reader is referred for these developments to the original papers.†

For an immediately available and mathematically up-to-date rating table, the paper by Professor E. V. Huntington should be consulted.

With the statistical procedures in use at the time (which closely approximate the corrected procedures) the scores obtained were such as could be expected by chance alone only once in such large numbers of repetitions as tax the imagination to picture. The total of *all trials made* during the first three years produced a deviation that required a figure of 820 digits to represent these odds. Numbers of researches reported since have added greatly to these huge values which argue with finality against a chance hypothesis.

* * *

The results, then, were not accidental; but there is a second critical concern in such a research, represented by the question whether the results have been fully reported and inclusively treated, with due care to avoid any unwitting selection which might favor the positive deviation and raise the odds against the expectation of its chance occurrence.

* *Journal of Parapsychology*, Duke University Press, Vol. I, Nos. 1, 2, 3, 4; Rhine, J. B., *Extra-Sensory Perception*, Boston, Bruce Humphries, 1934.

† Greenwood and Stuart, "Mathematical Techniques Used in ESP Research," *Journal of Parapsychology*, I (1937), 206-225. Huntington, E. V., "A Rating Table for Card-Matching Experiments," *Journal of Parapsychologyg*, I (1937), 292-294. Stuart and Greenwood, "A Review of Criticisms of the Mathematical Evaluation of ESP Data," *Journal of Parapsychology*, I (1937), 295-304. Sterne, T. E., "The Solution of a Problem in Probability," *Science*, LXXXVI (Nov. 26, 1937), 500. Greenwood, J. A., "Variance of a General Matching Problem," *Annals of Mathematical Statistics*, IX (1938), 56-59. Greville, T. N. E., "Exact Probabilities for the Matching Hypothesis," *Journal of Parapsychology*, II (1938), 55-59.

It was clearly pointed out in the first report of this research that all scores obtained for a given set of conditions were reported, whether high or low, favorable or unfavorable. The totals for the first three years' work on the ESP question, reported in *Extra-Sensory Perception*, were, as was repeatedly stated (*e.g.*, pp. 57, 58, 162 of the book just mentioned), complete for the period covered and for all the subjects tested. The eighteen further reports of research conducted by others which appear in Volume I of the *Journal of Parapsychology* are, it must be assumed on the good faith of the authors, likewise full reports of all relevant data obtained under the conditions described.

* * *

If, therefore, all the relevant results have been reported and if chance is not the explanation of them, a third issue of importance comes to the fore; namely, how adequate is the exclusion of sensory perception under the experimental conditions? That is, if it has to be granted that *perception* has occurred, what evidence is there that it was necessarily extra-sensory in character?

After the early explorations had amply shown that with opaque cards inverted before him the subject could name the card faces reliably above the mean chance expectation, the cards were then screened entirely from vision and touch, either by sealed opaque envelopes or by portable opaque screens; and in some experiments distances varying from about ten feet to several hundred miles were interposed between cards and subject, with walls intervening as additional screens.

It is highly probable (and there are no grounds to doubt) that the pre-screening tests were free from the weakness of affording opportunity for sensory cues, but in reaching a decision on ESP they may quite freely be eliminated and only the most clearly undisputed conditions regarded.

In a recent survey of the evidence in which were assembled only the results of tests where screens, opaque envelopes, or distance and walls were used to guarantee exclusion of sensory cues, there were found over 140,000 trials, with 118 subjects and 10 investigators, and which gave a deviation with a critical ratio of 30. The odds are 10^{195} to one that a set of scores so high as these would not arise by chance alone. All the data from all the tests in which vision and touch of any part of the cards during the run are entirely ruled out by the conditions reported are included in this summary, and the total deviation resulting is far beyond the scope of the chance theory.

We may, if we wish other restrictions, consider alone either the opaque envelope work or the portable screen work, or the distance-plus-walls work; it does not matter. Each block of results is significant in its own right. Or we may consider only that in which the distance is over 100 feet, that in which there were no open doors between the experimental rooms or in which there were independent objective records made by subject and experimenter. These further restrictions still leave reliable results with independent confirmatory experiments.

The hypothesis of *sensory cues* is therefore inadequate as an explanation of the ESP research, and along with the *chance hypothesis* and that of *improper selection* it must be rejected as inapplicable to the work under consideration.

although it must ever be kept in mind, like all alternative hypotheses, as each new experiment is undertaken.

* * *

In this, as in all situations where the only alternative is a sufficiently improbable one, we come eventually to question the research personnel itself. Who are the experimenters who find results confirmatory to the ESP hypothesis? (Those who report failure do not at this stage arouse concern.) Do they inspire confidence adequate to an acceptance of the almost incredible results and their very revolutionary implications?

It is important to remember that "acceptance" is a relative term and that the criteria vary widely with different persons. Also, the establishment of firm and unquestioning belief in science is rare for any new advance; a kind of working acceptance is much more common, and even this has its various degrees. As some one has said, one need not so much *believe as entertain* evidence of a new discovery. Is the personnel of the investigators such, then, as to warrant entertaining the hypothesis of ESP, taking it seriously, testing it logically and experimentally, and considering its bearings?

There is of course no mathematics available to cope with the probability that a given experimenter or set of experimenters is competent and trustworthy. There is, however, a need for a roughly weighed judgment of the "testimony" before the general proposition that "ESP is an acceptably probable occurrence" is endorsed by a thoughtful person. There is some lawful relation, even though it is unformulated, between degree of acceptance and number of qualified witnesses. This is evident in the simple fact that several independent observers who confirm each other carry considerably more conviction than one of equal standing.

But it is a question for the individual reader whether he require more "quantity" (*i.e.*, more independent confirmations) than those already in print. In the eighteen confirmatory articles published in the 1937 *Journal of Parapsychology*, there were ten different collegiate institutions involved; and in ten of the reports there were at least two observers responsible for some essential part of the research. And if more "witnesses" are desired, there is need only to wait for further issues of the above-mentioned *Journal*, or better, to try to institute another independent repetitive research to add to the evidence pro or con. So much for the point of *quantity!*

The *quality* of the investigators is quite as important to the reader's investment of confidence as the *number* who confirm the case for ESP. But, alas, again, there is possible only a non-mathematical judgment both of criteria and of qualifications. However, the incidence of deliberate trickery and of gross incompetence in academic research is known to be so low as to warrant a very low probability that so large a number of ESP experimenters are capable of this. In so simple a research procedure (among the most objectively clear-cut in experimental psychology) the incompetence necessary to provide the evidence reported would need to be phenomenal in the score and more of university men and women responsible. In the history of human error no such sweeping mass delusion among academic circles is on record.

The investigators are preponderantly young men and women, but measured by the indicia of achievement and honors appropriate to their age, they stand

high even among their own selected circles. Older men with established reputations are often loath to take up new tests of untried hypotheses; and even when they do so and obtain results, they often hesitate to attract attention to themselves by publishing their findings.*

* * *

The research here briefly reviewed, which was designed to test the dogma that stimuli cannot impress the mind except by way of the senses, has now reached wide proportions and covered a considerable period. It has been greatly reinforced at many points and by many persons, and the case for extra-sensory perception is enormously stronger today than it was in 1934 when the first report of the Duke experiments was published. If there is any fundamental error in the whole research, it ought to have become more evident as time has passed and many critics have tried their wits upon it. With the growing confidence in the basic soundness of the research, however, we must not become less watchful. Relentless criticism, in addition to our own resolution, is needed to help us against this danger.

But while any criticism is welcome, it should be recognized that before the case for extra-sensory perception is in any serious way and degree endangered, not only *the evidence from the best experimental conditions* must be shaken by criticism but *all the various sources of evidence* as well.

Criticism thus far in all instances with which I am familiar has been directed at points which at best would not dismiss the whole research from consideration. It is in no spirit of overconfidence, but instead with a desire for a clearly drawn issue, that I now suggest that the time is ripe for bringing the entire research program to a halt if it can be done by just and sound criticism. It is high time for one who by training and taste is prepared to do so, to undermine the whole structure if he can. If we are deluded, we shall be the better in the end for the rude awakening it would bring.

On the other hand, this is a stage through which all new fields have had to pass; and if we survive this necessary stage of criticism and doubt, we can feel the greater assurance on account of the vigorous tests through which we will have passed. Every worthwhile discovery has had to win its way against the resistance of a number of rigid-minded defenders of the scientific *status quo*. This must be expected and borne with patience. Against the perspective of the history of science, the research in extra-sensory perception is receiving relatively very fair consideration and treatment. It is safe, I think, to say that this is definite evidence of a growing tolerance for new and different ways of thinking.

* * *

This short presentation has dealt only with the question whether ESP occurs. It does not touch upon the considerable research which deals with the nature of ESP, its relation to various phenomena better known, and to the general conditions of space and time in connection with ESP. These researches, now in the hands of many experimenters and conducted in a number of institutions, are not merely adding to the evidence for ESP, but adding in many ways to our knowledge of its conditions and characteristics and its place in the natural order.

* In the March, 1938, *Journal of Parapsychology* a famous scientist reports conclusive results from several thousand trials made by himself under good conditions with clairvoyance tests, results such as would not be expected by chance alone once in 200,000 such series. *But he reports them anonymously!*

THE ADRENAL CORTEX AND CARBOHYDRATE METABOLISM*

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The term "metabolism" was first used in English in 1878 by Michael Foster who had borrowed it from the German biologist, Schwann. It is used to signify the chemical changes that occur in living organisms; and since these may either be of a synthetical or analytical character, the term "anabolism" is used for the former and "catabolism" for the latter.

The following discussion concerns the influence of the adrenal cortex upon the chemical changes undergone by carbohydrates on living organisms. Pretentious as this may sound, our real knowledge of these influences is, at the best, but fragmentary; and much remains to be done before an adequate explanation of them can be given.

THE NORMAL CARBOHYDRATE METABOLISM

A better understanding of the adrenal cortex will be obtained if I first briefly outline the main alterations in carbohydrate metabolism that occur in the normal animal.

TABLE I

NORMAL CARBOHYDRATE METABOLISM

I. *Digestion*—Carbohydrate of the diet. Glucose (fructose, galactose).

II. *Absorption of Glucose from the Intestine*—
- (a) By diffusion.
- (b) By selective action of mucosa (phosphorylation?).

III. *Disposition of Absorbed Glucose*—
- (a) Oxidation to CO_2 and H_2O (in all tissues) (50 percent).
- (b) Storage as liver and muscle glycogen (50 percent).

IV. *Liver Glycogen*—
- (a) Source— (1) Carbohydrate ingested in food.
  (2) From proteins of diet or tissues (gluconeogenesis).
- (b) Catabolism— Converted into glucose.
- (c) Function— (1) To maintain blood glucose at levels compatible with life, *i.e.*, above 40 mgs. percent.
  (2) To supply muscles with glucose for use in contractile processes.

* Presented before the Ohio State University Chapter.

V. *Muscle Glycogen*—

(a) Source— Blood glucose.

(b) Catabolism— Broken down through a series of three carbon compounds (lactic, pyruvic acid, etc.) to CO_2 and H_2O.

(c) Function— Process of contraction (work).

It is to be observed that as a result of the process of digestion the carbohydrates of the food are largely converted into glucose, and for the purposes of this article we may assume that the story of carbohydrate metabolism is that concerned with the chemical changes undergone by this monosaccharide in the body.

The passage of glucose through the intestinal wall does not depend on the simple process of diffusion, but is accelerated in a unique manner by the activity of the cells lining this organ. It is believed that this selective absorption of glucose is brought about by combining it with phosphoric acid, which, in view of the importance of phosphorylation processes in other stages of carbohydrate metabolism, does not seem to be an unlikely explanation.

Once the glucose has entered the blood stream it is disposed of by two main changes, (a) complete oxidation, (b) condensation into the polymeric form—glycogen. Within a reasonable period about half of a given amount of glucose is oxidised and the remainder converted into glycogen. Practically all the glycogen present in the body is found either in the liver or muscles, and it is in these sites that well-marked increases may be found after the administration of carbohydrates. The function of glycogen in these two organs is, however, somewhat different, and this difference in function is reflected in the manner in which further chemical changes occur as a result of cellular activity.

The liver glycogen is formed partly from the glucose reaching it from the alimentary tract, but also from one other very important source. This is from certain of the amino acids resulting from the catabolism of protein. Now, this protein may not only be that included in the food, but under certain conditions, such as fasting, the organism may use its own tissue proteins for the provision of its energy requirements. The production of glucose and glycogen from protein in the liver is spoken of "gluconeogenesis" and the importance of this mechanism will be realized when it is stated that a certain minimum level of blood glucose must be maintained at all times and under all conditions if the organism is to survive. An animal may be placed on a diet containing no carbohydrate or even fasted for long periods yet the blood glucose level will undergo but slight change.

A moment's consideration will show how necessary such a mechanism must have been for the continued existence of the animals that were often forced to go long periods without food or to exist on diets of almost exclusively protein and fat. Indeed, the recent work on the relation of certain endocrine glands to metabolism has shown that they actively participate in this process either by reducing the utilization of carbohydrate to a minimum or by increasing its production from protein.

In contrast to the liver glycogen which is the sole source of blood glucose, the muscle glycogen is concerned with the special function of this tissue alone and

tenaciously clings to its store of this carbohydrate even under the most severe conditions of bodily want.

The function of the muscles is the performance of work and the production of heat. In animals with a constant body temperature the latter is as important as the former. While it is probably true that for the production of heat the muscles can burn substances other than glycogen, the continuation of the contractile processes is believed to be dependent upon its breakdown. The product of glycogen breakdown in this instance is not glucose but involves a whole series of chain reactions by which glycogen is successively converted into hexose phosphates, three carbon derivatives, such as lactic and pyruvic acid, and finally carbon dioxide and water. The net result of these changes is the provision of energy for the performance of work and the liberation of heat. The replenishment of the glycogen stores of the muscles is accomplished by the removal of glucose from the blood so that, stated in its simplest form, we may say that the liver is the source of the glucose which is largely oxidised by the muscles.

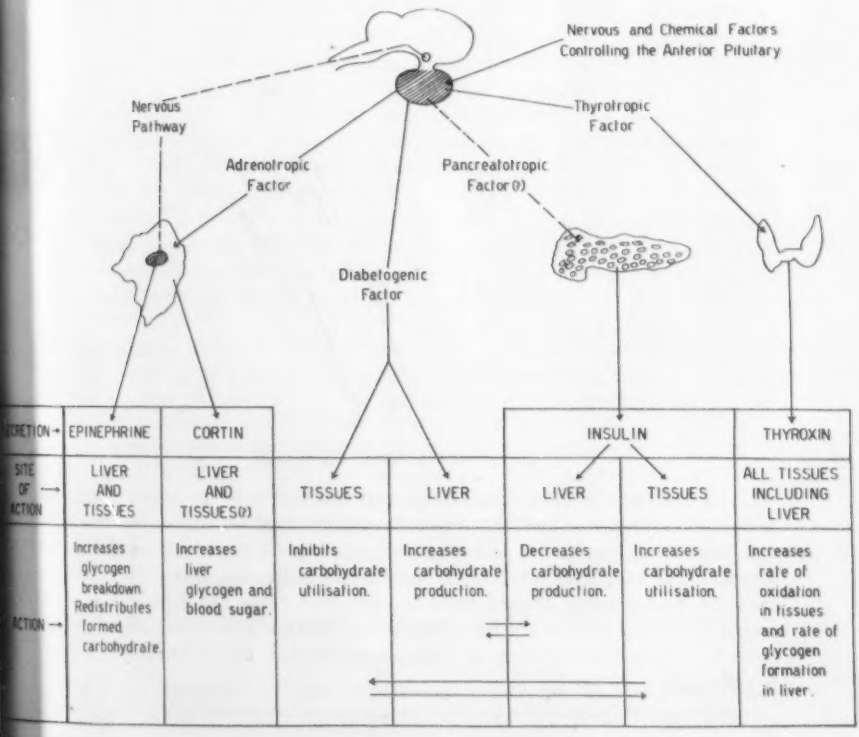

FIG. 1. The endocrine control of carbohydrate metabolism.

THE ENDOCRINE CONTROL OF CARBOHYDRATE METABOLISM

Now, where do the endocrine glands enter this picture? A detailed account of all their activities in this regard would take too long, but I have prepared a schematic outline which emphasizes the main relations as we understand them at present.

The main points to be noted are as follows: (a) The anterior pituitary is unique inasmuch as upon its secretions depends the functional integrity of at least two and possibly three other endocrine glands whose secretions in turn are essential for normal carbohydrate metabolism. This action of the anterior pituitary on other endocrine glands is spoken of as a "tropic" action and consequently we speak of an adrenotropic, a thyrotropic or a pancreatropic hormone. In addition to this indirect effect on metabolism it is probable that the secretions of the anterior pituitary exert a direct action upon the tissues as well. (b) The secretions of two endocrine glands (insulin and thyroxin or thyroglobulin) increase the rate of carbohyrate utilization in the body. The manner in which this is produced is different in each case and the time relations of the effects are also widely different. They also differ inasmuch as the thyroid hormone increases the general oxidation rate of all foodstuffs, whereas insulin specifically accelerates that of carbohydrate alone and does this largely, if not entirely, in the muscles. In fact, in the liver, its main effect is believed to be the suppression of gluconeogenesis from protein. (c) The hormones of the anterior pituitary and the adrenal cortex appear to act in a manner directly opposite to insulin; that is they diminish glucose utilization in the tissues and increase its production in the liver. (d) Finally epinephrine, the hormone of the adrenal medulla, brings about a redistribution of the carbohydrates already formed and there is also evidence that it may decrease glucose utilization in the tissues. The influence of this hormone under physiological conditions is only transitory as it is rapidly destroyed in the blood stream, and is apparently only secreted under conditions of emergency.

The above brief review of the general manner in which certain hormones influence carbohydrate metabolism enables us to discuss a little more completely the part played by that of the adrenal cortex.

THE ADRENAL CORTEX

This endocrine gland is found in all vertebrates, but in the mammal and bird it is incorporated with another organ, the adrenal medulla. Together these two constitute the suprarenal or adrenal glands, although it must be remembered that they not only have a different embryological derivation, but also a different function, the cortex being derived from the germinal ridge and having a common origin with the gonads, while the medulla is developed in the sympathetic nervous tissue.* The adrenal glands, as their name implies, are to be found in close proximity to the kidneys.

* In view of the common origin of the adrenal cortex and gonads it is perhaps not surprising that the active principles of these endocrine glands also have a close chemical relationship, since all are steroids. In addition, there is also a good deal of overlapping in their physiological activities. On the other hand, the hormone of the adrenal medulla is probably derived from the amino acid, tyrosine.

The complete removal of both adrenal glands and any accessory cortical tissue is followed by death within one to two weeks in all species so far examined. Since removal of the adrenal medulla does not cause death, it is apparent that a continued supply of the cortical hormone is essential for some vital process or processes.

The symptoms that follow such an operation in the dog, cat or rat are as follows: For a day or two nothing untoward is noted, then the appetite decreases as evidenced by the decreased food intake and this is often accompanied by vomiting and diarrhea. When complete refusal of food is observed death may be expected within a few days. This is preceded by marked muscular weakness, apathy, loss of weight; and in some species, particularly the cat and rat, convulsions. The body temperature falls and accompanying this is a fall in the rate of oxygen consumption.*

Chemical analyses of the body fluids reveal striking changes. These may be grouped as shown in table II.

It will be seen at once that marked changes occur in the water and electrolyte balance of the tissues and fluids as well as a generalized diminution in their carbohydrate content. There exists at the present time a rather wide difference of opinion as to the relative importance of the alterations in the electrolyte and carbohydrate components of the body in determining the death of the animal. This may seem, as an isolated fact, unworthy of serious consideration were it not for the implications that can be drawn from such studies as to the normal function of the cortical hormone. This difference of opinion has been deepened by the discovery that species differ in the extent to which the electrolyte balance and carbohydrate metabolism are deranged by adrenalectomy. Thus, in the dog, a marked alteration in the blood sugar is only infrequently seen prior to death, whereas very great changes in the electrolyte metabolism are always found. In other species the alterations in the electrolytes are not as severe but those in the carbohydrate levels are very marked. One curious and probably one very significant observation which has been repeatedly verified is that the administration of sodium salts in sufficient amounts will preserve the life of adrenalectomised animals. Even better results are obtained by reducing the potassium intake in the diet and increasing that of sodium. Under these circumstances the electrolyte balance of the animal remains normal, but, as we shall see, defects in carbohydrate metabolism can still be detected.

The further analysis of this present confusion need not concern us now, although ultimately some reconciliation must be found. In my opinion there is probably a common denominator that determines both the alterations in electrolyte and carbohydrate metabolism although whether this first affects the former or the latter I am not prepared to say at the moment.

CARBOHYDRATE METABOLISM IN ADRENALECTOMISED ANIMALS

The alterations observed in the carbohydrate metabolism of adrenalectomised animals such as the rat are: (a) a marked decrease in liver glycogen, particu-

* Destruction of the adrenal glands in man is followed by the clonocal condition known as Addison's disease. The symptomatology and alterations in the body chemistry are identical with those seen in adrenalectomised animals with the further addition of one feature not seen; this is the marked bronzing of the skin and mucous membranes.

TABLE II

CHIEF CHEMICAL CHANGES IN TISSUES AND FLUIDS OF ADRENALECTOMISED ANIMALS

	Intracellular compartment		*Extracellular compartment*	
	Muscles	*Liver*	*Blood serum, lymph and tissue fluids*	*Urine*
Water content	Increased	(?)	Decreased	Increased for a time
Potassium content	Increased	No change	Increased	Decreased
Sodium content	No change	No change	Decreased	Increased
Non-protein nitrogen	No change (?)	No change (?)	Terminal increase (renal failure)	Decreased
Carbohydrates	Glycogen decreased	Glycogen decreased	Glucose decreased	.....

larly on fasting; (b) a slower decrease in muscle glycogen; (c) a decrease in blood glucose often to levels at which life is known to be impossible. This is particularly seen in fasted animals; (d) an increased sensitivity to the hypoglycemic action of insulin; (e) a decreased ability to metabolize injected glucose as judged by its slow rate of removal from the blood and the comparative inability of the liver and muscles to form glycogen from it.

No one disputes that these alterations can occur, but at first it was argued that they were a consequence of the impaired vitality of the animal. That this argument is not the explanation is emphasized by the fact that adrenalectomised rats (and other animals) may be kept in seemingly good health for long periods by the administration of adequate amounts of sodium chloride, yet, even under these conditions, particularly when they are fasted, the above-mentioned disabilities in carbohydrate metabolism may still be observed.

Of particular interest is the fall in blood glucose on fasting since this reflects an inability of the liver to maintain this by conversion of protein to glucose. Some recent results of Mrs. H. C. Harrison in my laboratory show that even rigorous treatment of adrenalectomised rats with sodium salts does not prevent the development of severe hypoglycemia.

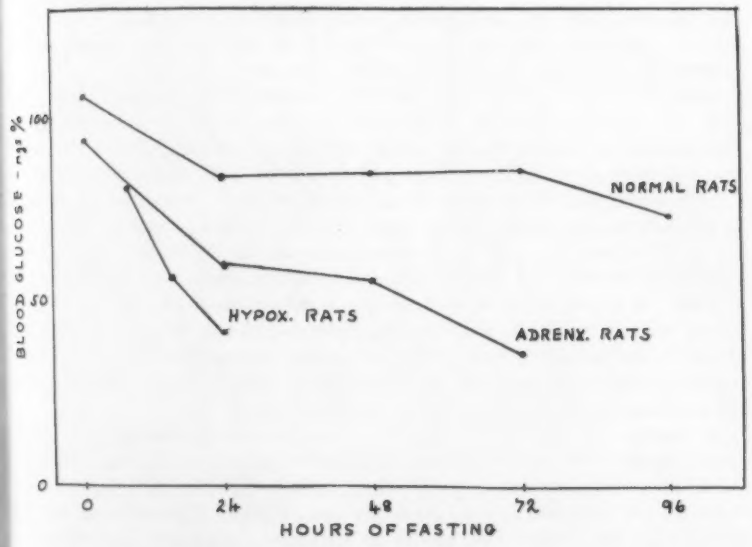

FIG. 2. The effect of fasting on the blood sugar level of normal, adrenalectomised and hypophysectomised rats. The adrenalectomised animals were injected with NaCl—NaH CO_3 solution twice daily.

Now, there are other conditions in which it becomes necessary for the organism to increase the formation of glucose from non-carbohydrate sources. Exercise, increasing as it does the utilization of carbohydrate, is one of these;

and Harrop comments that fighting amongst adrenalectomised dogs frequently precipitates hypoglycemia. An injection of insulin also requires a compensatory liberation of glucose from the liver and in adrenalectomised animals even small doses of this hormone cause profound hypoglycemia.

PANCREATIC DIABETES AND THE ADRENAL CORTEX

The most interesting condition of all and one that excites an excessive degree of gluconeogenesis, is pancreatic diabetes. Here, the removal of all insulin from the organism greatly reduces the ability of the tissues to utilize glucose which, in consequence, rise in the blood to such levels that it is excreted in the urine in large quantities. Consequently, and for reasons we cannot enter on now, the liver increases its production of glucose from protein and maintains the blood sugar at such excessively high levels that glycosuria continues even during fasting.

Bearing in mind the inability of fasted adrenalectomised animals to maintain their blood sugar, Lukens and I excised all of the pancreas and adrenals from cats and dogs. The results in table III indicate the alterations in the character of the diabetes that followed.

It will be seen that these doubly operated animals excreted much less glucose and nitrogen than the animals that were simply depancreatised. Since their survival was also extended it is permissible to say that the removal of the adrenals was followed by an amelioration of the diabetes.*

Attention is also called to the fact that removal of the pituitary gland along with the pancreas produces, if anything, an even greater amelioration of the diabetes and, in this regard, you will recall that our present evidence also places this endocrine gland as being concerned with glucose formation and utilization.

The connecting link between the analogous effects of removal of the adrenals or pituitary on pancreatic diabetes is possibly due to the fact that the presence of the latter is necessary for the functional integrity of the former, since marked anatomical shrinkage of the adrenal cortex follows removal of the pituitary in animals. It would, however, be unwise to conclude that all the effects of hypophysectomy on pancreatic diabetes are solely due to this cause since (a) other glands of internal secretion, *e.g.*, the thyroid, also undergo atrophy and (b) there is some evidence that certain of the effects of the anterior pituitary do not require the mediation of the adrenal cortex or thyroid gland.

It has recently been found possible to remove sufficient pancreas from white rats to render them severely diabetic and yet retain normal pancreatic digestion. These little diabetics are, in many ways, more useful for the type of experiments we are interested in than the larger cats or dogs. The economies effected by their use are in most laboratories an attractive inducement; but in addition their standard biological characteristics and the ease of operations upon them are even more valuable qualities.

When fully grown, the ingestion of a diet containing only about 11 percent of free carbohydrate may cause the excretion of as much as 10 grams of glucose

* Just prior to our first report, Hartmann and Brownell stated that, in a small series of depancreatised cats, total adrenalectomy was followed by an attenuation of the diabetes. Furthermore, they also noted a recrudescence of the diabetes when cortical extract was administered.

TABLE III

THE SURVIVAL AND EXCRETION DURING FASTING OF GLUCOSE, NITROGEN AND ACETONE BY VARIOUS CATS

				Urine				
Type of animal	*Number*		*Survival (days)*	*Glucose g/k/d**	*Nitrogen g/k/d**	*Acetone mgs/k/d**	*D — N*	*Blood sugar mgs./100 c.c.*
Depancreatised	22	Average	5.3	3.2	1.3	116	2.7	347
		Range	2–12	1.6–6.4	0.8–2.2	28–275		212–788
Hypophysectomised	19	Average	22.0	0.4	0.7	5	0.6	190
Depancreatised		Range	8–85	0.0–1.5	0.3–0.9	0–27		16–355
Adrenalectomised	18	Average	14.0	0.6	0.6	13	1.0	186
Depancreatised		Range	5–28	0.0–1.6	0.3–0.9	3–48		13–362

*Signifies gms. or mgms. a kilo. a day.

daily. If the human diabetic excreted amounts of this order on a comparable weight basis, then the impossible quantity of 1.5 to 2 kilograms of glucose would be lost to the body each day.

We have repeatedly seen adrenalectomy, but not removal of the adrenal medulla, bring about a virtual disappearance of these heavy glycosurias notwithstanding the fact that the animals were maintained in good health by the daily ingestion of adequate amounts of sodium chloride.

These experiments would again seem to emphasize what has already been stated with regard to the development of hypoglycemia in fasted adrenalectomised rats that the administration of sodium chloride, although maintaining a normal electrolyte balance, does not remedy the defects in the metabolism of carbohydrates.

THE ADRENAL CORTEX AND CARBOHYDRATE METABOLISM

The last statement leads to a consideration of the effects of the injection of extracts of the adrenal cortex upon the carbohydrate metabolism of adrenalectomised animals, either with or without pancreatic diabetes. Before beginning this let me add a few words about the remarkable work that in recent years has led not only to the preparation of potent extracts of this gland, but also to its chemical identification, and even more recently to the partial synthesis of the active principles.

About seven years ago, Hartmann, Swingle and Pfiffner, almost simultaneously prepared, by means of lipoid solvents, extracts of the adrenal cortex that were able to maintain adrenalectomised dogs and cats in good health for indefinite periods. The extensive work of Pfiffner and Wintersteiner, Kendall and his colleagues, and recently Reichstein, has demonstrated that several crystalline derivatives with life-maintaining properties may be isolated from these cortical extracts. These compounds are all steroids, that is they all possess the phenanthrene cyclo pentane nucleus, but their special biological activity appears to depend on the presence of an δ-B unsaturated ketone at carbon 3, and a short side chain containing the $CO\text{-}CH_2OH$ group at carbon 17.

Among the steroids are found a remarkable number of compounds with a diversity of biological actions including the male and female sex hormones; the anti-rachitic vitamins, and such apparently unrelated substances as certain carcinogenic agents, cardiac tonics, and toad poisons.

We have carried out studies on the effects not only of the crude extracts of the adrenal cortex on the carbohydrate metabolism of adrenalectomised animals, but also through the kindness of Dr. E. C. Kendall and Dr. O. Wintersteiner similar studies with certain of these active crystalline compounds.

In confirmation of some earlier work by Britton and his colleagues we have found that the administration of either the extract or a solution of these compounds by mouth or subcutaneous injection will restore the depleted carbohydrate reserves of adrenalectomised rats and mice. Not only this, but of even greater significance is that marked increases both in liver and muscle glycogen as well as in blood glucose may be observed even though the animals are fasted. It would seem impossible to escape the conclusion that, either directly or indirectly, this treatment has enabled the liver to once more form and preserve adequate quantities of glucose or glycogen from non-carbohydrate sources.

In partially depancreatised rats that had exhibited severe glycosuria prior to the removal of the adrenals this treatment immediately brings about a severe recrudescence of the glycosuria, which slowly subsides when the treatment is stopped, in spite of the fact that the administration of sodium chloride was continued throughout.

It is an accepted criterion of hormone action that their administration to normal animals should bring about alterations that in general are the reverse of those produced by the removal of the organs that secrete them. Thus, insulin, when given to normal animals, brings about a marked fall in blood sugar in direct contrast to the high blood sugar levels that follow removal of the pancreas.

Until recently, investigators were unable to detect any effects in normal animals from the administration of cortical extracts. This was undoubtedly due to the low potency of the extracts used since Hartmann and his colleagues as well as Harrop and Thorn have now reported that injections of either of the extracts or the crystalline compounds into normal men or animals leads to alterations in the electrolyte balance that may be roughly described as the opposite of those found in adrenalectomised animals. Thus they observe sodium retention, an increased potassium excretion, and a diminution in urine volume.

In consequence, the effect of an excess of this hormone on the carbohydrate metabolism of normal animals is of importance. Britton, and also Zwemer, have found that the injection of cortical extract brings about an increased glycogen content of the liver and muscles as well as a moderate degree of hyperglycemia.

Recently, Mr. Katzin, in my laboratory, has made an extensive study of the effects of both extract and the crystalline compounds on the carbohydrate metabolism of both fed and fasted normal rats and mice. The results were as follows: (a) The injection of the cortical hormone into fasted rats and mice at hourly intervals for eight to twelve hours causes a marked increase in the liver glycogen and a slight increase in the blood sugar; the muscle glycogen is, however, not affected. The mouse reacts to this treatment in a much more striking manner than the rat. Thus, mice that have been fasted for twelve hours have a liver glycogen of 0.25 g. percent while those just fasted and then injected for another ten hours have an average liver glycogen of 4.08 g. percent. In the rat first fasted for twenty-four hours and then injected the liver glycogen averages 1.08 g. percent in contrast to a value of 0.19 g. percent in the untreated controls.

In the fed mouse even more remarkable increases in liver glycogen were obtained. Here, the untreated animals had 2.65 g. percent of liver glycogen while the treated had no less than 9.90 g. percent, a value quite beyond any previously observed in this species. In this instance there was also a well-marked increase in the muscle glycogen from 0.43 g. percent to 1.04 g. percent. Blood glucose determinations have not yet been made but they cannot have been excessively high as no glucose appeared in the urine of the treated animals.

These results again raise the question as to the manner in which the cortical hormone brings about these increases in liver glycogen. Two explanations suggest themselves. (a) As mentioned earlier, the hormone may stimulate an

increased production of glucose from protein, in this case it might be expected that the urinary excretion of nitrogen would be increased particularly in the fasted animals. Some preliminary experiments in rats vigorously treated with cortical extract indicate that this does occur. (b) Another explanation is that the cortical hormone decreases the rate of glucose utilization in the tissues; and this may, in the normal animal, lead to an accumulation of liver glycogen. While this might be the case in fed animals where ample carbohydrate is available from the diet, it is a little more difficult to believe that this can be the only factor in fasted animals where the glucose utilization is already at a minimal level. A choice between these alternatives cannot yet be made, but at least the problem now seems well outlined and capable of fairly early solution.

THE EFFECT OF THE CORTICAL HORMONE ON THE CARBOHYDRATE METABOLISM OF HYPOPHYSECTOMISED ANIMALS

Finally, I should like to quote one more example of the effect of the cortical hormone on carbohydrate metabolism. I have left this to the last as it involves the introduction of complications in a field where you probably now think simplification is urgently needed. This time, let us briefly consider the carbohydrate metabolism of the hypophysectomised rat which, when fasted, develops a blood low sugar level and a marked depletion of the liver and muscle glycogen stores. Mr. Katzin and I have recently found that this depletion of the carbohydrate reserves of the fasted hypophysectomised rat can be almost entirely prevented by the administration of ample quantities of cortical extract or the crystalline compounds from this gland. In fact, the blood glucose and liver glycogen may be raised to levels not encountered in normal fasting rats; and furthermore if the carbohydrate levels are first depleted by a preliminary fast, then they may be again elevated by this treatment. In the treated animals there is also an increased nitrogen excretion which, together with the marked improvement in their physical condition, might be interpreted as indicating that one of the reasons for their inability to withstand fasting was a lack of the cortical hormone. I should like to again emphasize that the atrophy of the adrenal cortex that occurs in animals deprived of their anterior pituitary is additional evidence of a deficiency of this hormone.

I have attempted to show you that removal of the adrenal cortices is followed by certain alterations in carbohydrate metabolism that may be remedied by the cortical hormone. I have also pointed out that a study of pancreatic diabetes in animals deprived of these glands indicates the same thing; and that in normal animals well-marked alterations in carbohydrate metabolism are produced by an excess of this hormone. Finally, the striking effect of the cortical hormone on the carbohydrate levels of hypophysectomised rats is in agreement with my general conclusion that the adrenal cortex should be included amongst those organs of internal secretion that are concerned with the maintenance of what we speak of as a normal carbohydrate metabolism.

It is on these facts that I must now rest my case and leave you to judge whether the evidence I have presented is sufficient to justify the title of my address this evening.

REMARKS TO NEW MEMBERS*

W. C. George

You have just been initiated into a society of scholars—a society that has for its stated purpose the promotion of scientific research. At initiations it is considered fitting that the presiding officer should say a few words of encouragement to the younger brothers who have more recently set out upon the quest for some truths that may contribute towards a solution of problems of the natural world. Such words of encouragement may not be amiss, for times will come to all of you, doubtless, when it will seem that your efforts are futile and your lives barren.

There is some encouragement and some stimulus in merely recalling the names of Aristotle, of Galileo, of Newton, of Harvey, of Darwin, of Pasteur, of Walter Reed and other men of magnificent achievement in the history of science—men whose names are known throughout the civilized world. I wish I could say that arduous effort will surely yield each of you the reward of becoming a famous discoverer. But such is not the way things work out in the game of exploration and research. We may not all have the satisfaction and the glory of great achievement even with great and intelligent effort. Some of you will have the happy fortune to discover some bits of truth that fit into the framework of advancing knowledge, and the general praise that follows will be a satisfaction added to the autogenous satisfaction that comes from realization of work well done. The efforts of others may yield little fruit of new knowledge, or, perhaps, outlying bits of knowledge that do not fit into the contemporary framework and so appear to be of little significance and receive no praise. And yet the latter may be the greater scientists.

We know that there are stars of greater and stars of less brilliance in the night sky, but our eyes do not tell us correctly which are the greater and which are the lesser stars. The work of a brilliant or a lucky investigator occasionally illuminates the night of our ignorance like a meteor and arouses the admiration and the praise of all. But as the myriad less conspicuous points of light give permanent beauty to the night, so the multiude of little-known workers in the field of science contribute their beams of truth in the vault of our general ignorance. The contribution of most scientific workers is greater than is obvious.

Perhaps I can illustrate my thought further with another figure of speech. As crystals form here and there in a solution concentrated with salts, so new ideas originate and new discoveries are made in a world concentrated with thought. You may not all be beautiful crystals in the world of thought, but if you devote yourselves to science with zeal and honest minds you can contribute to the concentration that produces them.

* On the occasion of the spring initiation, University of North Carolina Chapter.

THE FLORIDA INSTALLATION

The seventy-sixth chapter of the Society of the Sigma Xi was installed October 28 at the University of Florida. With the enthusiastic and helpful cooperation of President Tigert of the University, the committee in charge of the installation, headed by Professor Christensen (Sigma Xi, Wisconsin, 1925) arranged and carried out a stately and dignified program, entirely worthy of the University, of the Society of the Sigma Xi, and of the cause which the Society represents. The program filled an entire day, part of which had been declared a University holiday by President Tigert and the administration. The Florida Chapter has set up a fine model for future installations.

The day's events began with a University convocation at 10.00 o'clock. A formal academic procession including distinguished guests, visitors, chapter and club delegates and all members of the University faculty preceded the convocation. Administrative officers, distinguished guests and speakers were seated on the rostrum. During the course of the program guests were introduced and invited to make remarks. The stimulating and scholarly convocation address, "Science and Research in Modern Civilization," by the Honorable M. L. Wilson, Undersecretary, United States Department of Agriculture, is reproduced in this issue of the QUARTERLY (page 161).

Professor Charles Carroll Brown (Sigma Xi, Union, 1887) was the guest of honor and delivered the principal address, "The History and Objective of Sigma Xi," at the luncheon held at 1.00 P.M. in the Florida Union dining hall. Professor Brown was the second president of Sigma Xi (1893-1895) and is the oldest living past president. His address was replete with interesting and instructive developments in the history and objectives of Sigma Xi.

Dean Leigh (Sigma Xi, Chicago, 1915) presided at the luncheon and introduced representatives of honor societies and scientific organizations of the campus and the state, who brought messages of greeting and congratulations, as follows:

Phi Beta Kappa	Dr. James Miller Leake, Vice-President, Beta Chapter of Florida, Phi Beta Kappa, and Head of the Department of History and Political Science, University of Florida
Phi Kappa Phi	Professor H. P. Constans, Vice-President, University of Florida Chapter, Phi Kappa Phi, and Head, Department of Speech, University of Florida
Florida Entomological Society	Dr. W. V. King, President, Florida Entomological Society, and Bureau of Entomology, Orlando
Florida Section, American Chemical Society	Professor Burton J. Otte, Chairman, Florida Section, American Chemical Society, and Member of Chemistry Staff, University of Florida

Florida Academy of Science	Dr. Robert I. Allen, President, Florida Academy of Science, and Head, Department of Physics, The John B. Stetson University, Deland

The formal installation was carried out according to the following schedule with Dr. Edward Ellery, National Secretary of the Society of the Sigma Xi, as installing officer.

Meeting called to order	Dr. P. H. Senn, President, University of Florida Sigma Xi Club
Presentation of installing officer by	Dr. P. H. Senn
Reading of the petition for the establishment of a chapter of Sigma Xi	Dr. B. V. Christensen, Chairman, Committee on Chapter
Announcement of the action of the Executive Committee and National Convention on the petition	Doctor Ellery
Adoption of the Chapter Constitution and By-laws	
Constitution and By-laws presented by	Dr. Wayne M. Neal, Chairman, Committee on Constitution and By-laws
Election and installation of chapter officers	
A. Report of Nomination Committee	Dr. Townes R. Leigh, Chairman
B. Election of officers	
C. Installation of officers	Dr. E. Ellery
Presentation of the charter for a chapter	Dr. E. Ellery
Acceptance of charter	Dr. P. H. Senn, newly elected president, Florida Chapter, The Society of the Sigma Xi
Charge to the chapter	Doctor Ellery

A reception and tea in honor of distinguished guests and visitors, sponsored by the University Woman's Club with Mrs. B. V. Christensen as Chairman of the General Committee in charge of arrangements, was held in the Bryan Lounge of the Florida Union following the installation. Dr. Jno. J. Tigert, President of the University, Dr. Edward Ellery, National Secretary, Sigma Xi, Dr. M. L. Wilson, Undersecretary of Agriculture, Washington, D. C., Dr. J. H. Sherman, President, University of Tampa, Dr. C. C. Brown, Past President, Sigma Xi, Dr. P. H. Senn, President, Florida Chapter of Sigma Xi, Dr Townes R. Leigh, Vice-President, University of Florida, and Dr. B. V. Christensen, General Chairman, installation program, were in the receiving line. Mrs. Jno. J. Tigert and Mrs. Townes R. Leigh were at the tea table.

The installation program was concluded with the formal installation banquet held in the Florida Union dining hall at 7.30 P.M. with Dr. P. H. Senn, newly elected President of the Florida Chapter, as toastmaster. Dr. Jno. J. Tigert, President of the University, extended a welcome to the chapter of the Sigma Xi and expressed pleasure and gratification for the establishment of a chapter at the University of Florida. An interesting feature of the program was the introduction of chapter and club delegates and reading of the list of chapters and clubs sending congratulatory messages. The installation address, "The Urge to Know,"* was delivered by Dr. Edward Ellery.

Chapters Represented by Delegates at the Installation of Florida Chapter of the Society of the Sigma Xi

SIGMA XI CHAPTERS

Rensselaer ..... Mr. William McMullen
Yale ..... Dr. James H. Elder
Minnesota ..... Dr. R. B. Becker
Iowa ..... Dr. W. J. Huss
Stanford ..... Mr. Charles T. Carnahan
Michigan ..... Dr. C. F. Byers
Missouri ..... Dr. Ouida Davis Abbott
Iowa State ..... Dr. Fred B. Smith
Rutgers ..... Dr. R. V. Allison
College of Medicine, University of Illinois ..... Dr. M. B. Marks
Wesleyan ..... Professor H. B. Dolbeare
Carleton ..... Dean T. R. Leigh
Oregon State ..... Dr. B. T. Sims

SIGMA XI CLUBS

University of Alabama ..... Dr. Walter B. Jones
University of Georgia ..... Dr. D. C. Boughton, Dr. George H. Boyd

Congratulatory Messages from Sigma Xi Chapters and Clubs

SIGMA XI CHAPTERS

Nebraska	Calif. Inst. of Tech.	Duke
Brown	Cincinnati	Calif. at Los Angeles
California	Lehigh	Mass. Inst. of Tech.
Illinois	Penn. State	Smith

* This address will be printed by the University of Florida and copies distributed to all chapters and clubs.

Northwestern
Washington University
McGill
Kentucky
Virginia
Oklahoma
Rochester
Pittsburgh
Western Reserve
Buffalo
George Washington
Utah
Rice
Wellesley

SIGMA XI CLUBS

Southern California
Univ. of Calif. at Davis
Clark University
Bucknell
Brigham Young
Texas Technical College
Virginia Poly. Inst.
Univ. of New Mexcio
Vermont
Beloit College
Emory University

NOTES FROM CHAPTERS AND CLUBS

The Carnegie Institute of Technology Chapter holds a General Science Colloqium four times a year at half past eleven in the Faculty Lounge followed by a luncheon. Topics presented last year were: "The Flow of Metals," by Professor Gensamer; "A Modern Cracking Unit," by Professor Monrad; "The Chemist Looks at Coal," by Doctor Howard; "Body Sensitivity to Mechanical and Electrical Vibration," by Professor von Haller Gilmer.

The North Dakota Chapter participates with other honor societies of the University in two special convocations each year. One of these, held in the autumn, emphasizes the honors that are open to students and the requirements for attaining them. The other, held in the spring, recognizes students and faculty members for achievements in their special field during the year.

The Rutgers Chapter has set aside a sum of $100 to start a loan fund for graduate students in Rutgers University, and an additional sum of $100 to establish a research grant for scientific workers in the university. These funds will be administered through the university authorities, who will act upon recommendations of the chapter.

The Minnesota Chapter sponsored its eleventh annual series of lectures by prominent faculty members under the general title of "Man and His Diet." The total attendance at the lectures which were given in the Cyrus Northrop Memorial Auditorium was about ten thousand. The lectures were given in February and were as follows:

"The Fundamentals of Nutrition," by Doctor Palmer; "The Feeding of the Child," by Doctor Stewart; "Fads, Fancies, and Fallacies in Adult Diets," by Doctor Wilder; "The Food Industries of Minnesota," by Doctor Bailey.

The Rochester Chapter held its annual Sigma Xi day in February with record audiences.

The District of Columbia Chapter, the only alumni chapter in the Society, elected as members in May, Dr. Charles Albert Browne, chief of chemistry and technical research in the Bureau of Chemistry and Soils; Mr. Clarence Herbert Swick, chief of astronomy and gravity in the Coast and Geodetic Survey; and Dr. Irvine Clifton Gardner, chief of the Section of Optical Instruments in the National Bureau of Standards.

The University of Alabama Sigma Xi Club held its annual graduate program in April when twelve graduate students of the university presented papers on the research work they were doing in their special fields.

The Sigma Xi Club of the University of California at Davis sponsored seven lectures during the academic year 1937-38.

The Sigma Xi Club of Oklahoma Agricultural and Mechanical College numbers forty-six members representing twenty-seven chapters. The club meets for dinner four times a year and the dinner is followed by an address on a scientific topic by some member of the faculty or by some guest.

SIGMA XI

HALF CENTURY RECORD AND HISTORY

Compiled by

HENRY BALDWIN WARD

and

EDWARD ELLERY

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Orders with check should be sent to the National Secretary, Edward Ellery, Union College, Schenectady, N. Y.

CHAPTER OFFICERS

List Furnished by the Secretaries of the Chapters

Chapter	President	Vice-President	Secretary	Treas
Cornell	K. M. Wiegand	J. R. Johnson	P. F. Sharp	A. J. Hes
Rensselaer	H. S. Van Klooster	H. E. Stevens	D. T. Smith	H. D. Hu
Union	F. J. Studer	E. M. Ligon	A. H. Fox	F. C. Sch
Kansas	H. B. Hungerford	A. W. Davidson	W. H. Schoewe	H. E. Jon
Yale	L. S. Stone	E. J. Miles	F. T. McNamara	W. W. Wa
Minnesota	L. S. Palmer	L. I. Smith	E. A. Donelson	W. H. Alle
Nebraska	E. N. Andersen	M. G. Gaba	M. A. Basoco	F. E. Mo
Ohio State	H. C. Sampson	L. H. Snyder	W. C. Fernelius	W. C. Fra
Pennsylvania	J. R. Kline	D. H. Wenrich	E. M. Landis	M. G. Pro
Brown	R. B. Lindsay	Z. R. Bliss	P. H. Mitchell	W. E. Bet
Iowa	H. O. Croft	Beth L. Wellman	W. F. Mengert	A. T. Cra
Stanford	E. Blackwelder	J. P. Baumberger	K. M. Cowdery	K. H. Cow
California	D. R. Hoagland	M. P. O'Brien	H. Kirby	D. M. Gre
Columbia	H. W. Webb	A. W. Thomas	D. P. Mitchell	D. P. Mit
Chicago	C. R. Moore	A. J. Dempster	H. C. Hesseltine	V. E. Joh
Michigan	A. H. Higbie	H. H. Willard	J. S. Gault	C. B. Slaw
Illinois	C. L. Metcalf	W. L. Schulz	E. G. Young	D. T. Engl
Case	F. E. Barnes	F. Whitacre	R. L. Burington	T. M. Fox
Indiana	G. S. Snoddy	R. J. Hartman	M. L. Lohman	R. L. Kro
Missouri	S. Brody	H. E. French	L. J. Wells	J. Q. Adam
Colorado	C. L. Eckel	F. G. Ebaugh	Hugo Rodeck	N. F. Wm
		F. G. Walz		
Northwestern	A. Weil	C. H. Behre	M. Dole	C. D. Tor
Syracuse	C. C. Spencer	W. Greene	V. F. Lindenman	Mildred Fo
Wisconsin	L. E. Noland	C. A. Richards	J. G. Winans	W. R. Sch
Univ. of Wash.	F. K. Kirsten	D. H. Loughridge	G. R. Shuck	F. M. Ward
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Purdue	M. G. Mellon	C. J. Klemme	E. J. Kohl	G. A. Hav
Washington Univ.	L. E. Stout	C. Cori	R. E. Woodson	J. J. Gar
Dist. of Columbia	V. du Vigneaud	N. H. Heck	O. S. Adams	Wm. Lesh
Texas	H. L. Lochte	H. F. Rosene	G. H. Fancher	M. B. Mor
Mayo Foundation	G. M. Higgins	J. L. Bollman	E. V. Allen	E. V. Alle
N. Carolina	E. T. Browne	H. M. Burlage	J. E. Magoffin	J. E. Mag
N. Dakota	Raymond C. Staley	E. O. North	A. R. Oliver	A. R. Oli
Iowa State	J. W. Woodrow	C. Y. Cannon	D. L. Holl	D. L. Hol
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McGill	J. B. Collip	B. P. Babkin	J. B. Phillips	W. B. Ros
		C. V. Christie		
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Idaho	E. C. Jahn	M. R. Kulp	H. S. Owens	J. A. Coo
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Maryland	C. G. Eichlin	C. E. White	R. Bamford	R. Bamfor
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Rochester	S. W. Clausen	J. E. Hoffmeister	K. W. Smith	K. W. Smi
Pittsburgh	J. S. Taylor	A. G. Worthing	A. E. Stainland	W. H. Eng
Harvard	P. W. Bridgman	S. Weiss	F. M. Carpenter	B. J. Bla
Western Reserve	T. Sollmann	F. Hovorka	J. C. Gray	L. D. Edw
Princeton	L. P. Eisenhart	G. E. Beggs	C. W. Bray	H. N. Alex
Duke	P. J. Kramer	W. J. Seeley	C. G. Bookhout	Bert Cum
California At Los Angeles	A. W. Bellamy	G. R. Robertson	A. H. Warner	W. M. Wh
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			F. E. Emery	
George Washington	L. W. Parr	F. W. Weida	J. B. Hansen	F. W. Joh
Utah	C. M. Blumenfeld	R. S. Lewis	S. Flowers	S. Flower
Carnegie Inst. of Technology	J. B. Rosenbach	C. R. Fettke	H. C. Howard	R. T. Gib
Oregon State	F. O. McMillan	D. C. Mote	W. E. Lawrence	D. E. Hol
Rice	A. C. Chandler		G. H. Richter	J. H. Pra
Massachusetts State	C. R. Fellers	W. S. Ritchie	H. Van Roekel	C. P. Alex
Wellesley	Ruth Johnstin	M. J. Zigler	H. W. Dodson	H. W. Kos
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SIGMA XI CLUBS

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...versity of	V. H. Young.....	.....	L. E. Porter.....	L. E. Porter
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...ersity	J. C. Ireland.....	D. I. Purdy.....	J. E. Webster.....	J. E. Webster
...ana A. and	D. B. Swingle.....	H. T. Ward.....	P. L. Copeland.....	P. L. Copeland
...College	L. M. Roderick.....	H. H. Flor.....	H. E. Wirth.....	H. E. Wirth
...na State	W. M. Craig.....	E. L. Reed.....	W. W. Yocum.....	.....
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...ersity of	S. A. Wingard.....	.....	W. L. Threlkeld.....	.....
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...ersity of	R. G. Stone.....	J. E. Wildish.....	L. Misbach.....	L. Misbach
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...ege	W. R. Adams.....	W. R. Adams.....	R. G. Daggs.....	R. G. Daggs
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...State Agric.	S. Maeser	J. S. Williams.....	L. B. Linford.....	L. B. Linford
...ge				
...Young	J. K. Nicholes.....	.....	M. Marshall	M. Marshall
...ersity	C. Welty	.....	N. Bennington	N. Bennington
...College				
...Polytechnic	W. D. Salmon.....	G. Volk	K. C. Barrons.....	.....

OFFICIAL ANNOUNCEMENTS

SIGMA XI EMBLEMS

All insignia of the Society are available only through the office of the National Secretary. They are made in various styles and sizes, and in white and yellow gold. Orders for these insignia are issued through chapter secretaries, and must be *prepaid*. Information about styles and prices may be obtained from chapter secretaries or the National Secretary.

DIPLOMAS FOR MEMBERS AND ASSOCIATES

These diplomas are available in any quantity at 10 cents each. Diplomas can be engraved with the name of the individual and of the chapter and the date of initiation at 25 cents each. Orders should be sent to the National Secretary, should specify whether for members or associates, and should be accompanied by check.

INDEX CARDS

Index cards for newly elected members and associates are available *gratis* upon requisition from chapter secretaries to the National Secretary. These cards should be made out in duplicate, one set being retained for chapter files and one set being sent to the National Secretary for filing in the permanent records of the national organization.

NATIONAL CONSTITUTION

Printed copies of the National Constitution, containing all amendments to date, and all recent interpretations as made by the national officers on request of chapters, are available at 9 cents each from the National Secretary.

CHANGES OF ADDRESSES

Chapter secretaries are asked to send to the National Secretary in October of each year changes in their enrollment lists as follows: 1. Names and addresses to be deleted from the previous list; 2. Names and addresses to be added to previous list; 3. Changes of addresses of those on previous list who may have moved to a new address since the list was submitted.

SIGMA XI STATIONERY

Stationery in the official color of the Society is now available for all chapters and clubs at $1 per 100 sheets and $1 per 100 envelopes. The letter sheets bear the Society's seal embossed in white but no printing. The envelopes are the official square envelopes used by the national officers. Printed heading on the sheets and printed corner cards on the envelopes can be provided at cost, when so desired.

EDWARD ELLERY,
National Secretary, Sigma Xi,
Union College,
Schenectady, N. Y.